IS 15658 (2006): Precast concrete blocks for paving - [CED 5: Flooring, Wall Finishing and Roofing]

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Indian Standard

PRECAST CONCRETE BLOCKS FOR PAVING — SPECIFICATION

ICS 93.080.20

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

June 2006

Price Group 8

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Flooring, Wall Finishing and Roofing Sectional Committee had been approved by the Civil Engineering Division Council.

Concrete paver blocks were first introduced in Holland in the fifties as replacement of paver bricks which had become scarce due to the post-war building construction boom. These blocks were rectangular in shape and had more or less the same size as the bricks. During the past five decades, the block shape has steadily evolved from non-interlocking to partially interlocking to fully interlocking to multiply interlocking shapes. Consequently, the pavements in which non-interlocking blocks are used are designated as 'Concrete Block Pavement (CBP)' or non-interlocking CBP, and those in which partially, fully or multiply interlocking blocks are used are designated as 'Interlocking Concrete Block Pavement (ICBP)'.

CBP/ICBP consists of a surface layer of small-element, solid un-reinforced pre-cast concrete paver blocks laid on a thin, compacted bedding material which is constructed over a properly profiled base course and is bounded by edge restraints/kerb stones. The block joints are filled using suitable fine material. A properly designed and constructed CBP/ICBP gives excellent performance when applied at locations where conventional systems have lower service life due to a number of geological, traffic, environmental and operational constraints. Many number of such applications for light, medium, heavy and very heavy traffic conditions are currently in practice around the world.

Different countries have adopted different norms for quality assurance of concrete blocks and construction and maintenance of CBP/ICBP, based on research and development and empirical advances in this field and suitable to the geological, traffic and environmental conditions prevailing in those countries. In India, research and development work in this field started at Central Road Research Institute in the nineties. Currently the Indian Institute of Technology (IIT), Kharagpur, has joined in the research and development efforts. Application of CBP/ICBP technique is finding increasing popularity around the country, especially in metropolitan cities as well as in large and medium towns. Currently a number of entrepreneurs are engaged in this business. Considering the increasing scope for application of this specialized paving technique, BIS recognizes the need to regulate the quality of paver blocks and CBP/ICBP so that the purchaser is ensured of uniformly good quality of blocks and CBP/ICBP. Accordingly, this standard specification for concrete paver blocks is being formulated.

In the formulation of this standard, assistance has been derived from the following publications:

a) EN 1338 : 2003 (E), Concrete Paving Blocks — Requirements and Test Methods, European Committee for Standardization, Rue de Stassart, 36, B1050, Brussels

b) CAN3-A231.2-M85 Pre-cast Concrete Pavers, Canadian Standards Association

c) AS/NZS 4456.5 : 1997 — Masonary Units and Segmental Pavers — Methods of Test — Method 5 : Determining breaking load of segmental paving units

d) IRC : SP-63-2004 — Guidelines for the Use of Interlocking Concrete Block Pavement

The composition of the Committee responsible for formulation of this standard is given at Annex J.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

AMENDMENT NO. 2 NOVEMBER 2011
TO
IS 15658 : 2006 PRECAST CONCRETE BLOCKS FOR PAVING — SPECIFICATION

[*Page* 5, *Table* 2, *col* 2 (*see also Amendment No.* 1)] — Substitute 'Plan area, *Max*, A_{sp}' *for* 'Plan area, *Min*, A_{sp}' at Sl No. vii).

(CED 5)

Reprography Unit, BIS, New Delhi, India

Indian Standard

PRECAST CONCRETE BLOCKS FOR PAVING — SPECIFICATION

1 SCOPE

1.1 This standard specifies constituent materials, products requirements and test methods for solid, un-reinforced pre-cast cement concrete paver blocks and complimentary products used for light, medium, heavy and very heavy traffic paving applications and other applications.

1.2 The standard does not cover concrete masonry units, cellular (hollow) concrete blocks, fly ash masonry blocks, permeable concrete blocks, grid blocks, grass stones and cement concrete flooring tiles.

2 REFERENCES

The standards listed in Annex A contain provisions which through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated in Annex A.

3 TERMINOLOGY

For the purpose of this standard, the following definitions shall apply.

3.1 Actual Dimension — Measured dimensions of a paver block.

3.2 Arris — Part of a block where two faces meet which can be bevelled, rounded, chamfered, or splayed, as shown in Fig. 1.

3.3 Aspect Ratio — The ratio of length to thickness of a paver block.

3.4 Backing Layer — Layer of concrete on the lower face of a two-layer paver block, made of material same as or different from that used in the wearing layer of the block.

3.5 Bed Face — That surface of a paver block which, when paved, comes in direct contact with the bedding material.

3.6 Chamfer — Bevelled arris, as shown in Fig. 1.

3.7 Chased Side Face — The side face of a paver block, having a recessed profile, as shown in Fig. 1.

3.8 Colour — Appearance of a paver block due to pigment used in concrete, other than natural cement colour.

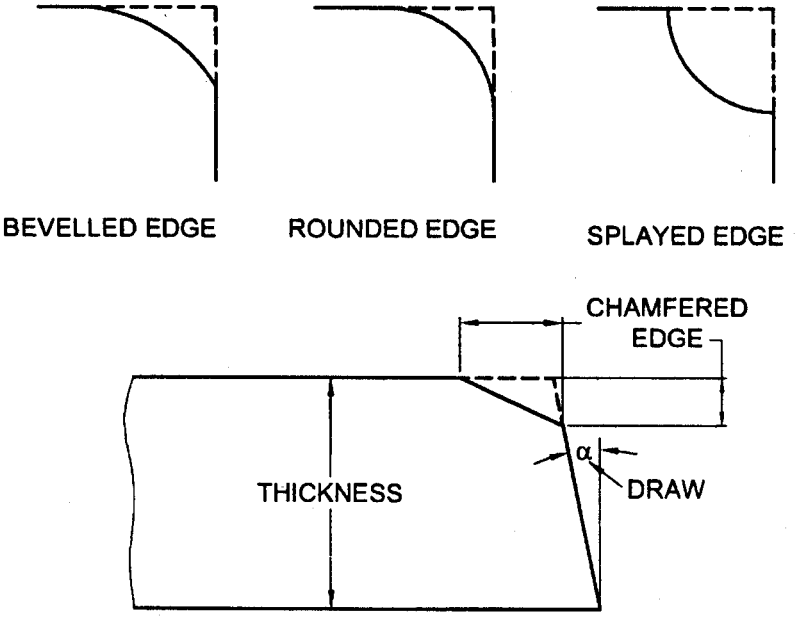


FIG. 1 EXAMPLES OF ARRIS (BEVELLED, ROUNDED, CHAMFERED) CHASED SIDE FACE AND DRAW

3.9 Complementary Product — A pre-cast usually of the shape of part of a block, used for fitting into gaps remaining in a block-paved area, for complete coverage of paved surface.

3.10 Draw — Intended angle of the side face from the vertical plane over the full height of a paver block, as shown in Fig. 1.

3.11 Efflorescence — White deposit formed on paver blocks due to diffusion of calcium hydroxide (solution slaked lime) present in cement, together with various dissolved salts, onto the external surface.

3.12 False Joints/Grooves — Regularly shaped depressions on the wearing layer of a paver block.

3.13 Format — Work dimensions of a paver block, specified in the order of overall length, overall width and thickness.

3.14 Interlocking Mechanism — The mechanism which allows adjacently paved blocks to key into one another and facilitates the sharing of shear, bending and thrust forces between adjacent blocks in a paved system.

3.15 Interlocking/Dentated/Inter-connected Paver Blocks — Paver blocks which key into one another on some or all vertical faces, when paved in any pattern.

3.16 Length — Shortest distance between farthest opposite vertical faces of a parallelopiped enclosing a paver block, excluding the dimensions due to any spacer nibs.

3.17 Overall Length — The longer side of a rectangle with the smallest area enclosing a paver block, excluding any spacer nibs.

3.18 Overall Width — Shorter side of a rectangle with the smallest area enclosing a paver block, excluding any spacer nibs.

3.19 Plan Area — Horizontal area bounded by the vertical faces of a paver block, excluding the area due to any spacer nibs.

3.20 Paver Block — Solid, un-reinforced pre-cast cement concrete paving units used in the surface course of pavements, with minimum horizontal cross-section of 50 mm from any edge in any direction, having aspect ratio not more than four, except for complementary products.

3.21 Pigment — Synthetic or natural colouring agents used in the concrete mix to produce coloured paver blocks.

3.22 Secondary Processing — Manufacturing process to texture the upper face of a paver block, executed before or after hardening of manufactured block.

3.23 Side Face — That face of a paver block which is generally in the vertical direction when paved and which faces adjacent block.

3.24 Skid Resistance — Resistance to relative movement between a vehicle tyre and the trafficked surface of a pavement.

3.25 Slip Resistance — Ability to resist relative movement between a pedestrian foot and the trafficked surface of a pavement.

3.26 Spacer Nibs — Small protruding profiles on the vertical face of a paver block used as a device for keeping minimum joint gap while paving blocks.

3.27 Squareness — Normally between the vertical faces of a paver block and the horizontal wearing surface, and parallelism between wearing surface and lower horizontal surface.

3.28 Surface Relief — Regularly shaped protrusions on the wearing surface of a paver block.

3.29 Surface Texture — Microscopic and macroscopic features of the wearing face of a paver block.

3.30 Thickness — Vertical distance between the upper face and bed face of a paver block.

3.31 Wearing Layer — Layer of concrete or mortar on the upper face of a two-layer paver block, made of material same as or different from that used in the backing layer of the block.

3.32 Wearing Face — That surface of a paver block which, when paved, faces the atmosphere and which is directly subjected to loading and movement of vehicle tyres or pedestrian traffic.

3.33 Wearing Face Area — Horizontal area bounded by the vertical faces of a paver block, minus the area reduced due to the presence of arris.

3.34 Width — Shortest distance between nearest opposite vertical faces or corners of a paver block.

3.35 Wipe — Fine cement mortar slurry applied to the upper face of a paver block or supplementary product.

3.36 Work Dimension — Any dimension of a paver block specified for its manufacture, to which the actual dimension should conform, within specified permissible tolerances.

4 MATERIALS

4.1 Cement and Cement Admixtures

4.1.1 Cement used shall be any of the following:

a) 33 Grade ordinary Portland cement conforming

to IS 269,

b) 43 Grade ordinary Portland cement conforming to IS 8112,

c) 53 Grade ordinary Portland cement conforming to IS 12269,

d) Portland slag cement conforming to IS 455,

e) Portland-pozzolana cement (fly ash based) conforming to IS 1489 (Part 1),

f) Portland-pozzolana cement (calcined clay based) conforming to IS 1489 (Part 2), and

g) Rapid hardening Portland cement conforming to IS 8041.

4.1.2 Mineral admixtures, namely, fly ash conforming to Grade 1 of IS 3812 (Part 1), silica fume conforming to IS 15388, ground granulated blast furnace slag conforming to IS 12089 and rice husk ash and metakaoline conforming to the requirements specified in IS 456 may be used as part replacement of ordinary portland cement provided uniform blending with cement is obtained.

4.2 Aggregates

4.2.1 *Coarse Aggregates*

4.2.1.1 Coarse aggregates shall comply with the requirements of IS 383. As far as possible crushed/ semi-crushed aggregates shall be used. For ensuring adequate durability, the aggregate used for production of blocks shall be sound and free of soft or honeycombed particles.

4.2.1.2 Other types of aggregates such as slag and crushed, over-burnt brick or tile which may be found suitable with regard to strength, durability of concrete and freedom from harmful effects may be used in preparation of concrete for production of paver blocks. However such aggregates shall not contain more than 0.5 percent of sulphates as SO_3 and shall not absorb more than 2 percent of their own mass of water.

4.2.1.3 Heavy weight aggregates or light weight aggregates such as bloated clay aggregates and sintered fly ash aggregates may also be used provided the purchaser is satisfied with the data on the properties of concrete made with them.

4.2.1.4 The nominal maximum size of coarse aggregates used in production of paver blocks shall be 12 mm.

4.2.2 *Fine Aggregates*

Fine aggregates shall conform to the requirements of IS 383. Both river/quarry sand and stone dust meeting the requirements can be used.

4.3 Admixtures

Admixtures, when used shall conform to IS 9103. Previous experience with and data on such materials should be considered in relation to the specified standards of mechanization, supervision and workmanship in production of blocks. They may be added for specific requirements without affecting other quality parameters.

4.4 Pigments

4.4.1 Synthetic or natural pigments may be used in concrete mix to obtain paver blocks with desired shades of colours. The pigment used should result in durable colours of paver blocks. It shall not contain matters detrimental to concrete. Pigments, either singly or in combination, conforming to the following Indian Standards may preferably be used:

Pigments	*Relevant Indian Standard*
Black or Red or Brown pigment	IS 44
Green pigment	IS 54
Blue pigment	IS 55
or	IS 56
White pigment	IS 411
Yellow pigment	IS 50

Pigment quantity to be restricted to a maximum of 9 percent by weight of cement content. The pigment should be finer than the cement (Fineness value between 2-15 m^2/kg).

4.4.2 The pigments shall not contain zinc compounds or organic dyes.

4.4.3 Lead pigments shall not be used unless otherwise specified by the purchaser.

4.5 Water

The water used in production of paving blocks shall conform to the requirements specified in IS 456.

5 GRADE DESIGNATION OF PAVER BLOCKS AND DESIGN OF CONCRETE BLOCK PAVEMENT

Recommended grades of paver blocks to be used for construction of pavements having different traffic categories are given in Table 1. Since zero slump concrete is used in production of paver blocks, the quality of blocks produced will depend upon various parameters like the capacity of compaction and vibration of machine, grade of cement used, water content, quality of aggregates used, their gradation and mix design adopted, additives used, handling equipment employed, curing methods adopted, level of supervision, workmanship and quality control achieved, etc.

Table 1 Recommended Grades of Paver Blocks for Different Traffic Categories

(*Clauses* 5 *and* 9.1.4)

Sl No.	Grade Designation of Paver Blocks	Specified Compressive Strength of Paver Blocks at 28 Days N/mm²	Traffic Category	Recommended Minimum Paver Block Thickness mm	Traffic Examples of Application
(1)	(2)	(3)	(4)	(5)	(6)
i)	M-30	30	Non-traffic	50	Building premises, monument premises, landscapes, public gardens/parks, domestic drives, paths and patios, embankment slopes, sand stabilization area, etc
ii)	M-35	35	Light-traffic	60	Pedestrian plazas, shopping complexes ramps, car parks, office driveways, housing colonies, office complexes, rural roads with low volume traffic, farm houses, beach sites, tourist resorts local authority footways, residential roads, etc
iii)	M-40	40	Medium-traffic	80	City streets, small and medium market roads, low volume roads, utility cuts on arterial roads, etc
iv)	M-50	50	Heavy-traffic	100	Bus terminals, industrial complexes, mandi houses, roads on expansive soils, factory floor, service stations, industrial pavements, etc
v)	M-55	55	Very heavy-traffic	120	Container terminals, ports, docks yards, mine access roads, bulk cargo handling areas, airport pavements, etc

NOTES

1 Non-traffic areas are defined as areas where no vehicular traffic occurs.

2 Light-traffic is defined as a daily traffic up to 150 commercial vehicles exceeding 30 kN laden weight, or an equivalent up to 0.5 million standard axles (MSA) for a design life of 20 years (A standard axle is defined as a single axle load of 81.6 kN).

3 Medium traffic is defined as a daily traffic of 150 – 450 commercial vehicles exceeding 30 kN laden weight, or an equivalent of 0.5 to 2.0 MSA for a design life of 20 years.

4 Heavy traffic is defined as a daily traffic of 450 – 1 500 commercial vehicles exceeding 30 kN laden weight, or an equivalent of 2.0 to 5.0 MSA for a design life of 20 years.

5 Very heavy-traffic is defined as a daily traffic of more than 1 500 commercial vehicles exceeding 30 kN laden weight, or an equivalent of more than 5.0 MSA for a design life of 20 years.

6 PHYSICAL REQUIREMENTS

6.1 General

6.1.1 The physical requirements of paver blocks are categorized into two groups, namely:

a) Obligatory requirements shall be for ensuring durability of pavements constructed with paver blocks as well as obtaining better levels of service in block paving work, and

b) Optional requirements shall be as per the specific demands of the purchaser. These are described in **6.2** and **6.3**.

6.1.2 All paver blocks shall be sound and free of cracks or other visual defects which will interfere with the proper paving of the unit or impair the strength or performance of the pavement constructed with the paver blocks.

6.1.3 When two layer paver blocks are manufactured there shall be proper bonding between the layers. Delamination between the layers shall not be permitted. The compressive strength of the two layer blocks shall meet the specified requirements.

6.1.4 When paver blocks with false joints, surface reliefs or projections are supplied, the same shall be specified. Also, the surface features shall be well formed and be devoid of any defects.

6.2 Obligatory Requirements

6.2.1 *Visual Inspection*

Visual inspection of quality of paver blocks shall be

carried out in natural daylight, prior to the tests for other properties. The inspection shall be conducted by the purchaser and the manufacturer jointly at a location agreed to between them, normally at the site or factory. Visual inspection shall be conducted as per **7.1**.

NOTE — When efflorescence occurs and it is not deleterious to the performance of the blocks in use and is not considered significant.

6.2.2 *Dimensions and Tolerances*

6.2.2.1 The recommended dimensions and tolerances for paver blocks, measured as per the method in Annex B, are given in Table 2. Minimum block thickness shall be 50 mm and maximum 120 mm. The thicknesses 60 mm, 80 mm, 100 mm and 120 mm will be considered as standard thicknesses under this specification.

6.2.2.2 All blocks manufactured to meet this specification shall have arris/chamfer as per the dimensions and tolerances given in Table 2.

6.2.3 *Thickness of Wearing Layer*

When paver blocks are manufactured in two layers, the wearing layer shall have minimum thickness as specified in Table 2. The thickness of the wearing layer shall be measured at several points along the periphery of the paver blocks. The arithmetic mean of the lowest two values shall be the minimum thickness of the wearing layer.

6.2.4 *Water Absorption*

The water absorption, being the average of three units, when determined in the manner described in Annex C, shall not be more than 6 percent by mass and in individual samples, the water absorption should be restricted to 7 percent.

6.2.5 *Compressive Strength*

6.2.5.1 Compressive strength of paver blocks shall be determined as per the method given in Annex D. Paver block strength shall be specified in terms of 28 days compressive strength. In case the compressive strength of paver blocks is determined for ages other than 28 days, the actual age at testing shall be reported. The average 28 days compressive strength of paver blocks shall meet the specified requirement. Individual paver block strength shall not be less than 85 percent of the specified strength. In case blocks of age less than 28 days are permitted to be supplied, correlation between 28 days strength and the strength at specified age for identified batch/mix of blocks shall be established.

6.2.5.2 The specified average 28 days compressive strengths of different grades of paver blocks are given in Table 3 and the minimum specified strengths of individual paver blocks are given in **6.2.5.1**.

Table 2 Recommended Dimensions and Tolerance for Paver Blocks

(*Clauses* 6.2.2.1, 6.2.2.2, 6.2.3 *and* 9.1.2)

Sl No.	Dimension	Measurement Method, Ref to	Recommended Values	Tolerance Limit for Paver Block	
				Thickness < 100 mm	Thickness ≥ 100 mm
(1)	(2)	(3)	(4)	(5)	(6)
i)	Width, W	Annex B	To be specified by manufacturer	± 2 mm	± 3 mm
ii)	Length, L	Annex B	To be specified by manufacturer	± 2 mm	± 3 mm
iii)	Thickness, T	Annex B	50 to 120 mm	± 3 mm	± 4 mm
iv)	Aspect ratio (L/T)	Annex B	Maximum : 4.0	+ 0.2	+ 0.2
v)	Arris/chamfer	Annex B	Minimum: 5 mm Maximum : 7 mm	± 1 mm	± 1 mm
vi)	Thickness of wearing layer	**6.2.3**	Minimum : 6 mm	+ 2 mm	+ 2 mm
vii)	Plan area, A_{SP}	Annex B	Maximum : 0.03 m^2	+ 0.001m^2	+ 0.001m^2
viii)	Wearing face area, A_{SW}	Annex B	Minimum 75 percent of Plan Area	− 1 percent	− 1 percent
ix)	Squareness	Annex B	Nil	± 2 mm	± 3 mm

Table 3 Compressive Strength Requirements of Concrete Paver Blocks

(*Clauses* 6.2.5.2 *and* 9.1.4)

Sl No.	Grade of Paver Blocks	Minimum Average 28 Days Compressive Strength N/mm^2
(1)	(2)	(3)
i)	M-30	$\geq f_{ck} + 0.825 \times$ established standard deviation (rounded off to nearest 0.5 N/mm^2)
ii)	M-35	
iii)	M-40	
iv)	M-50	
v)	M-55	

6.2.6 *Abrasion Resistance*

The abrasion resistance of paver blocks should be determined as per the method given in Annex E. It may be specified the limits to the test results, which should be complied with by the manufacturer.

6.3 Optional Requirements

6.3.1 *Tensile Splitting Strength*

The tensile splitting strength of paver blocks should be determined as per the method given in Annex F. When required by the purchaser, the test values for tensile splitting strength of paver blocks may be specified by the manufacturer.

6.3.2 *Flexural Strength/Breaking Load*

The flexural strength/breaking load of paver blocks should be determined as per the method given in Annex G. When required by the purchaser, the test values for flexural strength breaking load of paver blocks may be specified by the manufacturer.

6.3.3 *Freeze-Thaw Durability*

The freeze-thaw durability test of paver blocks should be conducted as per the method given in Annex H. When required for application in freez-thaw environment, the purchaser may specify limits to the test results, which should be complied with by the manufacturer.

6.3.4 *Colour and Texture*

When required, the colour and texture of paver blocks should be mutually agreed to between the purchaser and the manufacturer.

7 TEST METHODS

7.1 Visual inspection shall be conducted by first examining each paver block from a sample lot for any elimination. The blocks shall then be laid out on a level floor in any desired paving pattern, approximately covering a square area of 1 m^2. Any visual defects of paver blocks, including cracks and flaking, shall be recorded by observing the paved blocks from a distance of approximately 2 m from each edge of the paved area. The texture and colour of the paver blocks shall be compared with the manufacturer's free samples supplies earlier to the purchaser.

7.2 Tests other than for visual aspects shall be carried out in a laboratory agreed to between the purchaser and the manufacturer. Wherever applicable, calibrated equipment shall be used for tests.

7.3 Compliance with the obligatory physical requirements laid down in **6.2** shall be ensured by conducting tests as described in Annexes B to E. Compliance with optional physical requirements laid down in **6.3** shall be ensured by conducting tests as described in Annexes F to H.

7.4 Unless otherwise specified in the enquiry or order, the cost of the tests shall be borne as follows:

a) By the manufacturer, in the event of the test results showing that the paver blocks do not conform to this specification, or

b) By the purchaser, in the event of the test results showing that the paver blocks conform to this specification.

8 SAMPLING

8.1 When the product has been submitted to an assessment of conformity by a third party, acceptance testing is not required, except in case of dispute between the purchaser and the manufacturer, when acceptance testing may be carried out. In such cases, depending upon the circumstances of the case in dispute, the required number of blocks shall be sampled from each batch of the consignment of blocks up to a quantity of 50 000 blocks.

8.2 When the product has not been submitted to an assessment of conformity by a third party, the required number of blocks shall be sampled from each batch of the consignment of blocks up to a quantity of 25 000 blocks.

8.3 When the quantity of a partial batch is less than half of the quantities mentioned in **8.1** and **8.2**, that partial batch of the consignment shall be added to the previous full batch.

8.4 The paver blocks selected for testing shall be representative of the consignment, the points of selection being evenly distributed through the consignment.

8.5 The number of blocks to be sampled from each batch for each test shall be as given in Table 4.

Table 4 Sampling Requirements

(*Clause* 8.5)

Sl No.	Property	Requirement Ref to Cl No.	Test Method Ref to	Number of Paver Blocks for Test	
				Quality Assurance by Third Party	Quality Assurance by Manufacturer/ Purchaser[1)]
(1)	(2)	(3)	(4)	(5)	(6)
i)	Visual Inspection	6.2.1	7.1	8[2)]	4 (16)[2)]
ii)	Dimensions	6.2.2	Annex B	8[2)]	4 (16)[2)]
iii)	Thickness of wearing layer[3)]	6.2.3	6.2.3	8[2)]	4 (16)[2)]
iv)	Water absorption	6.2.4	Annex C	3	3
v)	Compressive strength	6.2.5	Annex D	8	4 (16)
vi)	Tensile splitting strength	6.3.1	Annex E	8	4 (16)
vii)	Flexural strength/ breaking load	6.3.2	Annex F	8	4 (16)
viii)	Abrasion resistance	6.2.6	Annex G	8	4 (16)
ix)	Freeze-thaw durability	6.3.3	Annex H	3	3

[1)] The number within brackets is the number to be sampled to avoid secondary sampling from the batch if on the basis of the conformity criteria, additional blocks are required to be tested to assess conformity.

[2)] These blocks may be used for subsequent tests.

[3)] Only apply for blocks with a separate every layer.

8.6 The sample paver blocks shall be marked for future identification of the consignment it represents. The block shall be kept under cover and protected from extreme conditions of temperature, relative humidity and wind till they are required for test. The test shall be undertaken as soon as practicable after the sample has been taken.

9 ACCEPTANCE CRITERIA

9.1 Obligatory Requirements

9.1.1 The lot shall be considered as conforming to the requirements of this specification if the conditions mentioned in **9.1.2** to **9.1.4** are satisfied.

9.1.2 The sampled blocks tested for dimensions, aspect ratio, chamfer, plan area, wearing face area, deviation from squareness, and, in the case of two layer blocks, thickness of wearing layer shall meet the tolerance limit specified in Table 2. Blocks with visual defects with sample lot shall not be more than three.

9.1.3 For water absorption, the mean value of 3 samples determined shall be not more than the maximum limit specified in **6.2.4**.

9.1.4 The 28 days compressive strengths and tolerance of 8 numbers of paver blocks manufactured as per the grades of paver blocks recommended in Table 1 shall be as given in Table 3.

9.2 Optional Requirements

Acceptance criteria for optional requirements shall be as per mutual agreement by the purchaser and manufacturer.

10 MARKING

10.1 Concrete paver block/package shall be marked with the following information suitably:

a) Identification of the manufacturer,

b) Grade of paver blocks, and

c) Date of manufacture.

10.2 BIS Certification Marking

The paver blocks may also be marked with the Standard Mark.

10.2.1 The use of the Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act,* 1986 and the Rules and Regulations made thereunder. The details of conditions under which a licence for use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

ANNEX A

(*Clause* 2)

LIST OF REFERRED INDIAN STANDARDS

IS No.	*Title*
44 : 1991	Specification for iron oxide pigments for paints (*second revision*)
50 : 1980	Specification for lead and scarlet chromes (*third revision*)
54 : 1988	Specification for green oxide of chromium for paints (*second revision*)
55 : 1970	Specification for ultramarine blue for paints (*first revision*)
56 : 1993	Specification for Prussian blue (iron blue) for paints (*second revision*)
269 : 1989	Specification for 33 grade ordinary Portland cement (*fourth revision*)
383 : 1970	Specification for coarse and fine aggregates from natural sources for concrete (*third revision*)
411 : 1991	Specification for titanium dioxide, anatase, for paints (*third revision*)
455 : 1989	Specification for Portland slag cement *(fourth revision*)
456 : 2000	Code of practice for plain and reinforced concrete *(fourth revision*)
516 : 1959	Method of test for strength of concrete
1237 : 1980	Specification for cement concrete flooring tiles (*first revision*)
1489	Specification for Portland Pozzolana cement:
(Part 1) : 1991	Fly ash based (*third revision*)
(Part 2) : 1991	Calcined clay based (*third revision*)
2185 (Part 1) : 1979	Specification for concrete masonry units: Part 1 Hollow and solid concrete blocks (*second revision*)
3812 (Part 1) : 2003	Specification for pulverized fuel ash: Part 1 For use as pozzolona in cement, cement mortar and concrete (*second revision*)
8041 : 1990	Specification for rapid hardening Portland cement (*second revision*)
8112 : 1989	Specification for 43 grade ordinary Portland cement (*first revision*)
9103 : 1999	Specification for concrete admixtures (*first revision*)
12089 : 1987	Specification for granulated slag for manufacture of Portland slag cement
12269 : 1987	Specification for 53 grade ordinary Portland cement
15388 : 2003	Specification for silica fume

ANNEX B

(*Clauses* 6.2.2.1, 7.3 *and* D-4.1 and *Tables* 2 *and* 4)

METHOD FOR DETERMINATION OF DIMENSIONS, ASPECT RATIO, PLAN AREA, WEARING FACE AREA AND DEVIATION FROM SQUARENESS

B-1 LENGTH, WIDTH, THICKNESS AND ASPECT RATIO

B-1.1 Apparatus

The apparatus shall comprise:

a) Steel callipers, and

b) Steel rule capable of measuring up to 300 mm to an accuracy of 0.5 mm.

B-1.2 Specimens

The paver block specimens, selected from the group of blocks of specified shape, size and thickness as per the sampling procedure in **8** and as per the number of specimens mentioned in Table 4 shall be tested.

B-1.3 Procedure

B-1.3.1 *Length and Width*

The length and width of the specimen (*see* Fig. 2) shall be measured across two opposite faces by using the steel callipers or steel rule. Two representative positions shall be used for measurement of length and three for measurement of width. The mean values of length and width for the block shall be noted to the nearest 1 mm.

B-1.3.2 *Thickness*

The thickness of the specimen (*see* Fig. 2) shall be measured at four different positions. The mean value of the thickness of the block shall be noted to the nearest 1 mm.

B-1.3.3 *Aspect Ratio*

The aspect ratio of the specimen shall be calculated by dividing the mean length by the mean depth as determined by the procedures in **B-1.3.1** and **B-1.3.2** and shall be noted to the nearest 0.1.

B-2 ARRIS

B-2.1 Apparatus

The apparatus shall comprise of steel callipers.

B-2.2 Specimens

The paver block specimens selected as per the sampling procedure in **8** and as per the number of specimens mentioned in Table 4 shall be tested.

B-2.3 Procedure

The depth and width of arris of the specimen (*see* Fig. 2) shall be measured across two opposite faces, to the nearest 0.1 mm, by using the steel callipers. Four representative positions shall be used for measurement of depth and width. The mean values of depth and width of arris for the block shall be noted to the nearest 0.1 mm.

B-3 PLAN AREA AND WEARING FACE AREA

B-3.1 Apparatus

The apparatus shall comprise:

a) Balance capable of weighing 1 N to an accuracy of 0.000 1 N;

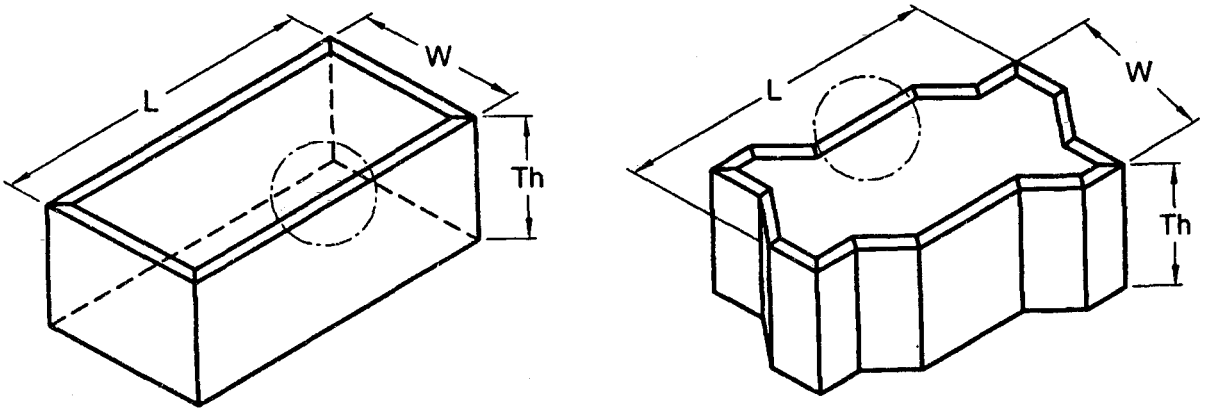


FIG. 2 LENGTH (*L*), WIDTH (*W*) AND THICKNESS (*Th*) OF PAVER BLOCKS

b) Sheets of thin cardboard of uniform thickness;

c) Sharp pencil;

d) Odd-leg marking gauge (*see* Fig. 3);

e) Sharp scissors; and

f) Steel rule marked with graduations of 0.5 mm.

B-3.2 Specimens

The paver block specimens selected as per the sampling procedure in 8 and as per the number of specimens mentioned in Table 4 shall be tested.

B-3.3 Procedure

B-3.3.1 *Plan Area (A_{sp}) (Method 1)*

The test specimen shall then be weighed, while suspended by a metal wire, and completely submerged in water, and the weight shall be recorded in N to the nearest 0.01 N (W_a). They shall be removed from the water and allowed to drain for one minute by placing them on a 10 mm or coarser wire mesh. Visible water on the specimen shall be removed with a damp cloth. The specimen shall then be immediately weighed and the weight for each specimen noted in N to the nearest $0.01N(W_w)$. The volume of the specimen shall be calculated as follows:

$$\text{Volume} = (W_w - W_a)\ 10^{-3}\ \text{m}^3$$

The thickness of the specimen in mm shall be determined as per **B-1.3.2**. The volume shall be divided by thickness to obtain plan area in mm^2.

In the case of rectangular specimens, the plan area may also be calculated by multiplying the length by the width, as determined by the procedure in **B-1.3.1**.

B-3.3.2 *Plan Area (A_{sp}) (Method 2)*

The specimen shall be placed, wearing face facing up, on the cardboard and its perimeter traced with the pencil. The shape shall be cut out accurately with the scissors and weighed to the nearest 0.000 1 N, and the result recorded as mass m_{sp}. A rectangle measuring 200 mm × 100 mm, accurately cut out from the same cardboard, shall also be weighed to the nearest 0.000 1 N, and the result recorded as mass m_{std}. The plan area for the block shall be calculated from the

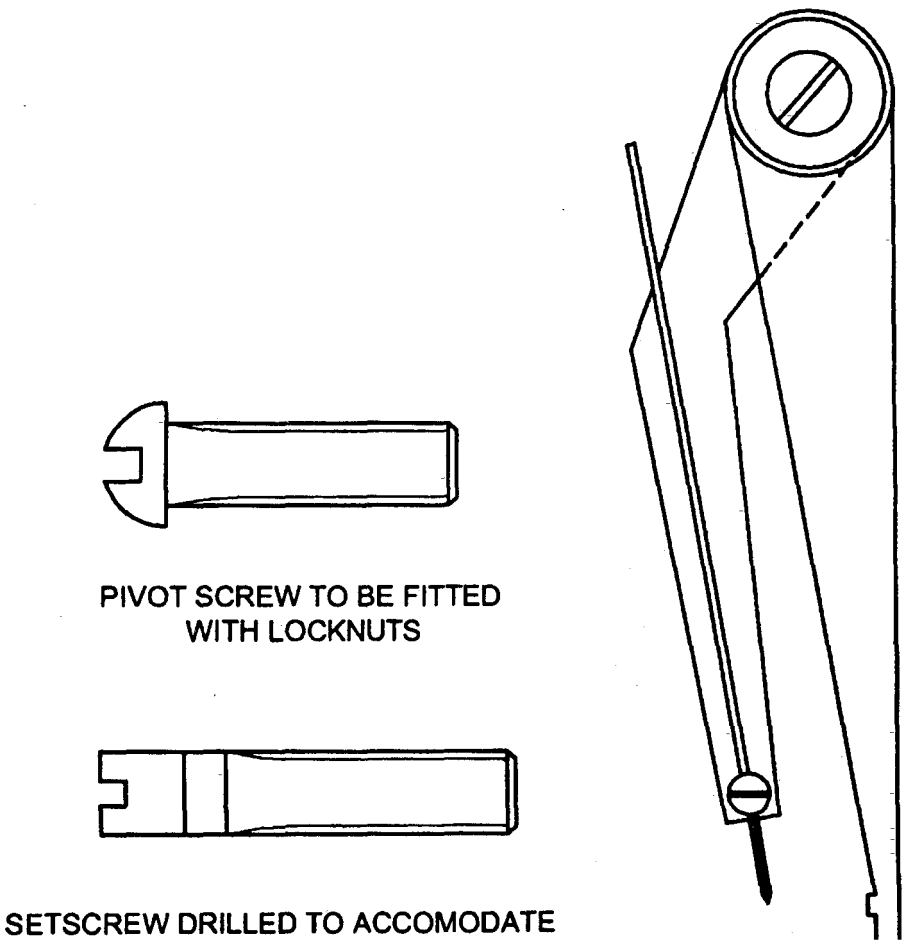


FIG. 2 LENGTH (L), WIDTH (W) AND THICKNESS (Th) OF PAVER BLOCKS

formula:

$$A_{sp} = \frac{20\,000\, m_{sp}}{m_{std}} \text{ mm}^2$$

B-3.3.3 *Wearing Face Area (A_{sw})*

The width of the arris of the block shall be measured at four different locations and their mean value determined. A ballpoint pen refill shall be fixed to the odd-leg marking gauge and the gauge shall be set to the measured mean value of width of the arris. The gauge so set shall be used to draw a line, indicating the width of the arris, along the periphery of the cardboard shape of the plan area of the block with mass m_{sp}, as obtained in **B-3.3.2**. The marked arris width on the cardboard shall be neatly cut away with the scissors, and the cardboard shall be weighed to the nearest 0.000 1 N and the result recorded as mass m_{sw}. The wearing face area for the block shall be calculated from the formula:

$$A_{sw} = \frac{20\,000\, m_{sp}}{m_{std}} \text{ mm}^2$$

B-4 DEVIATION FROM SQUARENESS

B-4.1 Apparatus

The apparatus shall comprise:

a) Engineer's square or a profiled template, and

b) Feeler gauges.

B-4.2 Specimens

The paver block specimens selected as per the sampling procedure in 8 and as per the number of specimens mentioned in Table 4 shall be tested.

B-4.3 Procedure

With the stock of the square or profiled template in contact with the top or bottom surface of the block, the blade shall be brought into contact with the vertical face of the block. The clearance, if any, between the square or profiled template and the vertical face of the block shall be measured to the nearest 0.1 mm with the feeler gauge at points 10 mm inside each top and bottom edge of the block. This measurement shall be repeated at six sensibly different locations around the block, and the average of the feeler gauge measurement noted as the deviation from squareness for the block, which shall be noted to the nearest 0.1 mm.

B-5 REPORT

The individual and average values of measured dimensions, arris, aspect ratio, plan area, wearing face area and deviation from squareness of specimens tested as per **B-1, B-2, B-3** and **B-4** shall be reported.

ANNEX C

(*Clauses* 6.2.4 *and* 7.3 and *Table* 4)

METHOD FOR DETERMINATION OF WATER ABSORPTION

C-1 APPARATUS

The balance used shall be sensitive to within 0.5 percent of the mass of the smallest specimen tested.

C-2 SPECIMENS

The paver block specimens selected as per the sampling procedure in **8** and as per the number of specimens mentioned in Table 4 shall be tested.

C-3 PROCEDURE

C-3.1 Saturation

The test specimen shall be completely immersed in water at room temperature for 24 ± 2 h. The specimen then shall be removed from the water and allowed to drain for 1 min by placing them on a 10 mm or coarser wire mesh. Visible water on the specimens shall be removed with a damp cloth. The specimen shall be immediately weighed and the weight for each specimen noted in N to the nearest 0.01 N (W_w).

C-3.2 Drying

Subsequent to saturation, the specimens shall be dried in a ventilated oven at 107 ± 7°C for not less than 24 h and until two successive weighing at intervals of 2 h show an increment of loss not greater than 0.2 percent of the previously determined mass of the specimen. The dry weight of each specimen (W_d) shall be recorded in N to the nearest 0.01N.

C-4 CALCULATION

C-4.1 Percent Water Absorption (W Percent)

The percent water absorption shall be calculated as follows:

$$W \text{ percent} = \frac{W_w - W_d}{W_d} \times 100$$

C-5 REPORT

The individual and average values of measured water absorption of specimens tested as per **C-1** to **C-4** shall be reported.

ANNEX D

(*Clauses* 6.2.5.1 *and* 7.3 and *Table* 4)

METHOD FOR DETERMINATION OF COMPRESSIVE STRENGTH

D-1 APPARATUS

D-1.1 Testing Machine

The apparatus shall comprise of compression testing machine which shall be equipped with two steel bearing blocks for holding the specimen. It is desirable that the blocks have a minimum hardness of 60 (HRC) and a minimum thickness of 25 mm. The block on top through which load is transmitted to the specimen shall be spherically seated. The block below on which the specimen is placed shall be rigidly fitted. When the bearing area of the steel blocks is not sufficient to cover the bearing area of the paver block specimen, two steel bearing plates meeting the requirements of **D-1.2** shall be placed between the steel plates fitted on the machine and the specimen.

D-1.2 Steel Bearing Blocks and Plates

The surfaces of the steel bearing blocks and plates shall not depart from the plane by more than 0.025 mm in any 15 mm dimension. The centre of the sphere of the spherically seated upper bearing block shall coincide with the centre of the bearing surface. If bearing plate is used, the centre of the sphere of the upper bearing block shall be on a line passing vertically through the centroid of the specimen bearing face. The spherically seated block shall be held closely in its seat, but shall be free to turn in any direction. The diameter of the face of the bearing blocks shall be at least 150 mm. When steel plates are employed between the steel bearing blocks and the specimen, the plates shall have a thickness equal to at least one-third the distance from the edge of the bearing block to the most distant corner of the specimen. In no case shall the plate thickness be less than 12 mm.

D-2 SPECIMENS

The paver block specimens selected as per the sampling procedure in **8** and as per the number of specimens mentioned in Table 4 shall be tested.

D-3 CAPPING OF SPECIMENS

D-3.1 The upper face of the specimens shall be capped by one of the methods described in **C-3.1** and **C-3.2** of Annex C of IS 2185 (Part 1).

D-3.2 Alternatively, 4 mm thick plywood sheets of size larger than the specimens by a margin of at least 5 mm from all edges of the specimen shall be used for capping the specimens.

D-3.3 When specimen with surface projections or surface relief features has to be tested, its upper face shall be made plain by suitable capping, such as by using sulphur or gypsum, before testing.

D-4 PROCEDURE

D-4.1 The dimensions and plan areas of the specimens shall be determined as described in Annex B. The blocks shall be stored for 24 ± 4 h in water maintained at a temperature of 20 ± 5°C. The bearing plates of the testing machine shall be wiped clean. The specimens are aligned with those of the bearing plates.

D-4.2 The load shall be applied without shock and increased continuously at a rate of 15 ± 3 N/mm^2/min until no greater load can be sustained by the specimen or delamination occurs. The maximum load applied to the specimen shall be noted in *N*.

D-5 CALCULATION

The apparent compressive strength of individual specimen shall be calculated by dividing the maximum load (in *N*) by the plan area (in mm^2). The corrected compressive strength shall be calculated by multiplying the apparent compressive strength by the appropriate correction factor from Table 5. The strength shall be expressed to the nearest 0.1 N/mm^2.

Table 5 Correction Factors for Thickness and Arris/Chamfer of Paver Block for Calculation of Compressive Strength

Sl No.	Paver Block Thickness mm	Correction Factor for	
		Plain Block	Arrised/Chamfered Block
(1)	(2)	(3)	(4)
i)	50	0.96	1.03
ii)	60	1.00	1.06
iii)	80	1.12	1.18
iv)	100	1.18	1.24
v)	120	1.28	1.34

For other thickness of paver blocks between 50 mm and 120 mm, linear extrapolation of concrete factor shall be made.

D-6 REPORT

The individual and average compressive strength of the specimens tested as per **D-1** to **D-5** shall be reported.

ANNEX E

(*Clauses* 6.2.6 *and* 7.3 and *Table* 4)

METHOD FOR DETERMINATION OF ABRASION RESISTANCE

E-1 APPARATUS

The abrasion testing machine shall be the same as described in Annex F of IS 1237 (*see* Fig. 4).

E-2 SPECIMENS

E-2.1 Square-shaped specimens measuring 71.0 ± 0.5 mm shall be cut from the block specimens selected as per the sampling procedure in **8** and as per the number of specimens mentioned in Table 4. The contact face and the opposite face of the specimen shall be parallel and flat. For determining the reduction in thickness as described in **E-4**, the opposite face shall, if appropriate, be ground parallel or otherwise machined so as to be parallel.

E-2.2 For testing dry specimens, the specimens shall be dried to constant mass at a temperature of 105 ± 5°C.

E-2.3 For testing wet/saturated specimens; the specimens shall be immersed in water for 7 days and wiped with a damp artificial sponge prior to each weighing (*see* **E-3**) so that all specimens appear equally damp.

E-3 PROCEDURE

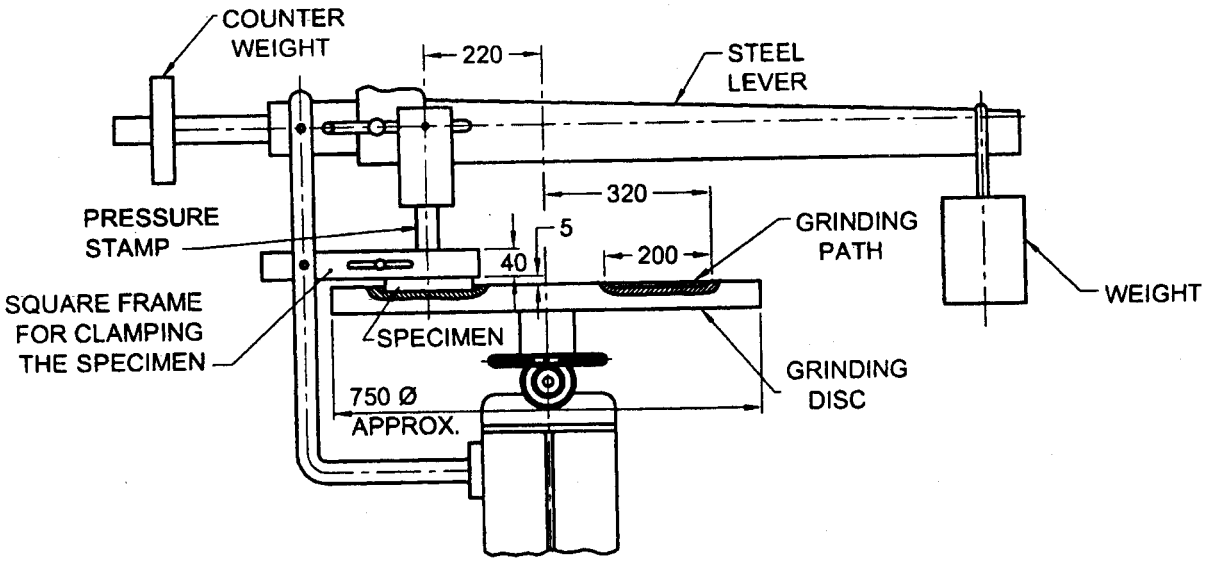
E-3.1 The density of the specimen, *PR* shall be determined nearest to 0.1 g. The weight of the specimen shall be noted to nearest 0.1 g both prior to the abrasion test and after every four cycles (*see* **E-4**).

E-3.2 In the case of two-layer specimens, the density of specimens taken separately from the wearing layer shall be determined.

E-3.3 The grinding path of the disc of the abrasion testing machine shall be evenly strewn with 20 g of the standard abrasive powder as per **F-3** of IS 1237. The specimen shall be fixed in the holding device such that the testing surface faces the grinding disc. The specimen shall be centrally loaded with 294 ± 3 N.

E-3.4 The grinding disc shall be run at a speed of 30 rpm. The disc shall be stopped after one cycle of 22 revolutions. The disc and contact face of the specimen shall be cleaned of abrasive powder and debris. The specimen shall be turned 90° in the clockwise direction and 20 g of abrasive powder shall be evenly strewn on the testing track before starting the next cycle.

E-3.5 When testing wet/saturated specimens, prior to each cycle, the track shall be wiped with a lightly damp artificial sponge and moistened before being strewn with the abrasive powder. From the start of the test, arrangement shall be made for drip-wetting of the central portion of the track, about 30 mm from the specimen (opposite to the direction of motion of



All dimensions in millimetres.

FIG. 4 GENERAL FEATURES OF ABRASION TESTING MACHINE

the disc), by supplying water drops at the rate of 180 to 200 drops (13 ml) per minute. During this test, it should be ensured that the abrasive powder continuously returns to the effective area of the track.

E-3.6 The test cycle shall be repeated 16 times, the specimen being turned 90° in the clockwise direction and spreading of 20 g of abrasive powder on the testing track after each cycle.

E-4 CALCULATION

The abrasive wear of the specimen after 16 cycles of testing shall be calculated as the mean loss in specimen volume, ΔV, from the equation:

$$\Delta V = \frac{\Delta m}{PR}$$

Where :

ΔV = loss in volume after 16 cycle, in mm^3;

Δm = loss in mass after 16 cycles, in g; and

PR = density of the specimen, or in the case of two-layer specimens, the density of the wearing layer, in g/mm^3.

E-5 REPORT

The abrasive wear shall be reported to the nearest whole number of 1 000 mm^3 per 5 000 mm^2.

ANNEX F

(*Clauses* 6.3.1 *and* 7.3 and *Table* 4)

METHOD FOR DETERMINATION OF TENSILE SPLITTING STRENGTH

F-1 APPARATUS

F-1.1 The testing machine shall have a scale with an accuracy of ± 3 percent over the range of the anticipated test loads and be capable of increasing the load at specified rates. The machine shall be equipped with a device composed of two rigid bearers (*see* Fig. 5) whose contact surface has a radius of 75 ± 5 mm. The two bearers shall be held in the same vertical plane with a tolerance of ± 1 mm at the bearers' end. The upper bearer shall be able to rotate in its transverse axis. The two packing pieces shall be 15 ± 1 mm wide (*see* 'b' in Fig. 5), 4 ± 1 mm thick (*see* 'a' in Fig. 5) and at least 10 mm longer than the anticipated fracture plane. The packing pieces shall be made of a material that meets the hardness criterion given in **F-1.2**.

F-1.2 When submitted to a punching test by means of a rod of circular cross-section, having a diameter of 16 ± 0.5 mm and applying a force at the rate of 48 ± 3 kN/min, the instantaneous penetration when the force of 20 ± 5 kN is achieved shall be equal to 1.2 ± 0.4 mm.

F-2 SPECIMENS

The paver block specimens selected as per the sampling procedure in **8** and as per the number of specimens mentioned in Table 4 shall be tested.

F-3 PREPARATION

Whole specimens shall be used and any burrs, high spots, etc, shall be removed. In case a face is rough, textured or curved, it shall be prepared by grinding or capping. The least amount of material shall be removed to obtain a flat face. The specimens shall be immersed in water at 20 ± 5°C for 24 ± 3 h, removed, wiped dry and immediately tested. Other methods of preparation may be used for routine testing, provided there is a correlation between the two methods, for example, using ungrounded rough textured or curved specimens instead of ground specimens.

F-4 PROCEDURE

F-4.1 The specimen shall be placed on the testing machine with the packing pieces on the upper face and the bed face, in contact with the bearers. It shall be ensured that the packing pieces and the axes of the bearers are in line with the splitting section of the specimen. The splitting section shall be chosen according to the following order of priority:

a) The test is carried out along the longest splitting section of the specimen, parallel and symmetrical to the edges, in such a way that the distance of the splitting section to any side face is at least 0.5 times the thickness of the specimen over at least 75 percent of splitting section area.

b) If the condition in (a) cannot be met, the test is carried out along two splitting sections, chosen in such a way that the distance from one splitting section to the other splitting section or to any side face of the specimen is at least 0.5 times the thickness of the specimen over at least 75 percent of the splitting section length considered.

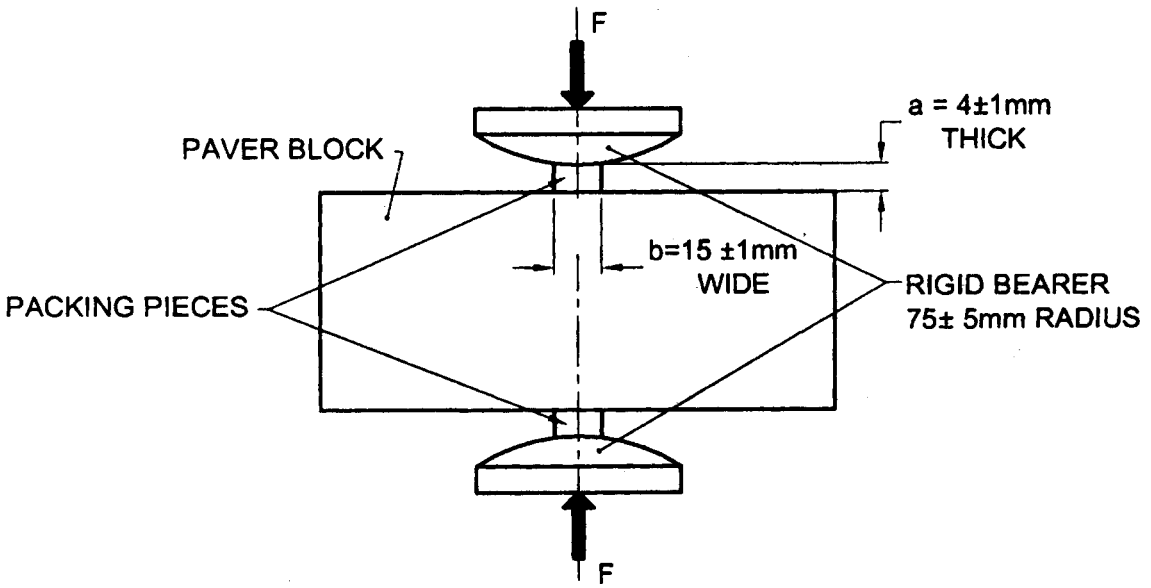


FIG. 5 TENSILE SPLITTING STRENGTH TEST SETUP

c) If neither of the conditions in (a) or (b) can be met, the splitting section shall be chosen in such a way that the greatest total proportional section length satisfying the distance requirement is obtained.

d) In case the section of the specimen is square, hexagonal or circular in plan, the splitting section shall be chosen in such a way that it is the shortest length passing through the centre of the plan area.

F-4.2 The load is smoothly and progressively applied at a rate which corresponds to an increase in stress of 0.05 ± 0.01 MPa. The failure load (P) is recorded in N, to the nearest 0.01 N.

F-5 CALCULATION

F- 5.1 The area of the failure plane(s) of the specimen tested are calculated from the equation:

$$S = l \times t$$

where

S = area of the failure, in mm^2;

l = mean of two measurements of the failure length, one at the top and one at the bottom of the specimen, in mm; and

t = mean of three measurements of thickness at the failure plane, one in the middle and one at either end, in mm.

F-5.2 The tensile splitting strength of the test specimen is calculated from the equation:

$$T = 0.637 \times k \times (P/S)$$

where

T = tensile splitting strength, in MPa; and

P = failure load N.

F-5.3 The failure load per unit length of the specimen is calculated for the equation:

$$F = (P/l)$$

where F is the failure load, in N/mm.

F-5.4 If testing is conducted along two transverse sections of the same specimen, the splitting tensile strength of the specimen is the mean of the two individual results.

F-6 REPORT

The test report shall include the following information:

a) T, the tensile splitting strength of the specimen to the nearest 0.1 MPa; and

b) F, the failure load per unit length of the specimen to the nearest 10 N/mm.

ANNEX G

(*Clauses* 6.3.2 *and* 7.3 and *Table* 4)

METHOD FOR DETERMINATION OF FLEXURAL STRENGTH/BREAKING LOAD

G-1 APPARATUS

The apparatus for the test shall be the same as in **8** of IS 516, with the following modifications:

a) The supporting and loading rollers shall have diameter in the range of 25 to 40 mm. They shall extend on both sides beyond the dimensions of the specimens by at least 10 mm;

b) The distance from centre-to-centre of the two supporting rollers shall be adjustable to the overall length of the specimen minus 50 mm; and

c) The loading roller shall be arranged for application of load from the top of the specimen along the vertical centreline between the supporting rollers.

G-2 SPECIMENS

The paver block specimens selected as per the sampling procedure in **8** and as per the number of specimens in Table 4 shall be tested.

G-3 CAPPING OF SPECIMENS

G-3.1 The test specimens shall be capped by one of the methods described in **D-3** of Annex D.

G-3.2 When specimen with surface projections or surface relief features has to be tested, its upper face shall be made plain by suitable capping, such as by using sulphur or gypsum before testing.

G-4 PROCEDURE

The test procedure shall be the same as in **8** of IS 516, with the following modifications:

a) The load shall be applied from the top of the specimen in the form of a simple beam loading through a roller placed midway between the supporting rollers, as shown in Fig. 6. Loading of irregular-shaped specimens shall be as shown in Fig. 7.

b) The load shall be applied without shock and increased continuously at a uniform rate of 6 kN/min.

c) The load shall be increased until the specimen fails, and the maximum load applied shall be recorded to the nearest *N*.

G-5 CALCULATION

The flexural strength of the specimen shall be calculated as follows:

$$F_b = \frac{3Pl}{2bd^2}$$

where

f_b = flexural strength, in N/mm^2;

P = maximum load , in *N*;

l = distance between central lines of supporting rollers, in mm;

b = average width of block, measured from both faces of the specimen, in mm; and

d = average thickness, measured from both ends of the fracture line, in mm.

The maximum load P shall be reported as the breaking load, nearest to 1 *N*.

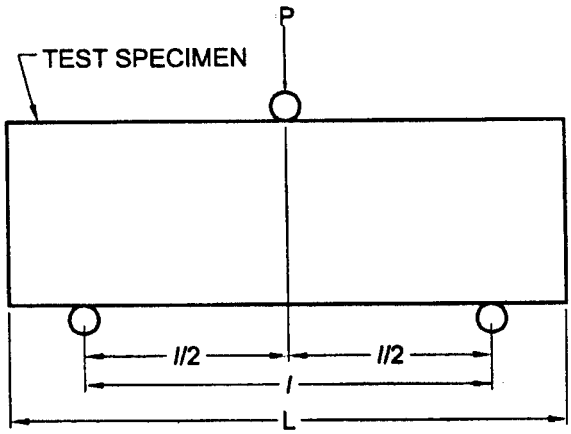
G-6 REPORT

The individual and average flexural strength and breaking load of the specimens tested as per **G-1** to **G-5** shall be reported.

G-7 SUGGESTED VALUES OF CHARACTERISTIC BREAKING LOAD

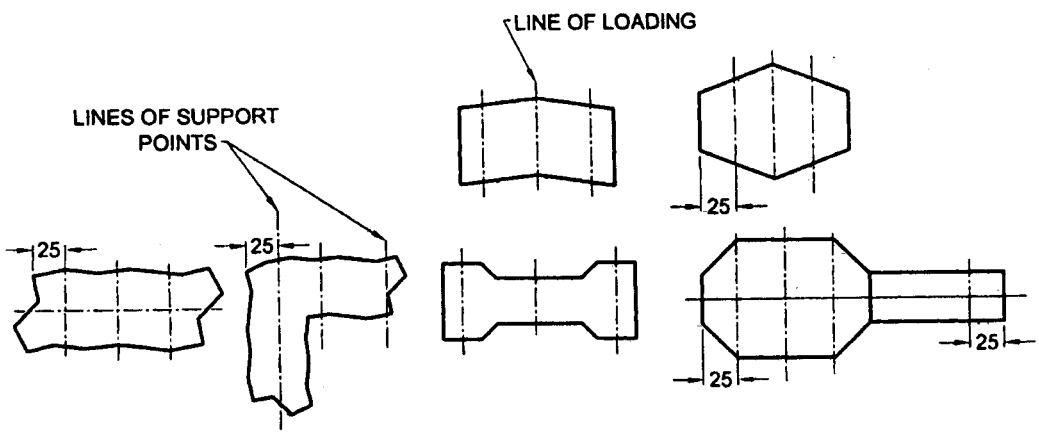
The suggested values of minimum breaking load for different applications are given below:

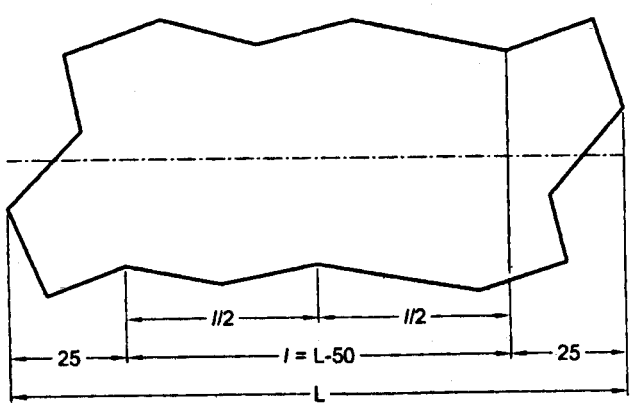
Application	*Minimum Breaking Load,* kN
Residential pathways/public pedestrian paths	2
Residential driveways — Light vehicles/public pedestrian and light vehicle paths	3
Residential driveways — Commercial vehicles/public pedestrian and commercial vehicle paths	5
Regularly trafficked roads	6
Heavy duty/industrial roads	7



L - OVERALL LENGTH OF THE SPECIMEN PARALLEL TO THE LONGITUDINAL AXIS (mm)
l - OVERALL LENGTH 50mm
P - LOAD

FIG. 6 METHOD OF LOADING TEST SPECIMEN FOR FLEXURAL STRENGTH/BREAKING LOAD





All dimensions in millimetres.

FIG. 7 LOADING OF COMMON IRREGULAR SHAPES OF FLEXURAL STRENGTH/BREAKING LOAD TEST

ANNEX H

(*Clauses* 6.3.3 *and* 7.3 and *Table* 4)

METHOD OF DETERMINATION OF FREEZE-THAW DURABILITY

H-1 SCOPE

This method covers the determination of the resistance of concrete paver blocks to repeated cycles of freezing and thawing when fully submerged in 3 percent sodium chloride solution.

H-2 APPARATUS

H-2.1 The freezing apparatus shall consist of a suitable cabinet or cold room with controls to reach and maintain an air temperature of −15 ± 2°C within 1 h of the introduction of specimens.

H-2.2 The thawing chamber (cabinet or room) shall be suitable to maintain a controlled air temperature of 23 ± 3°C.

H-2.3 The moist chamber (cabinet or room) shall be suitable to maintain a controlled air temperature of 23 ± 2°C and a relative humidity of 90 percent. If storage in water is desirable, a saturated lime solution shall be used, and the temperature shall be maintained at 23 ± 2°C.

H-2.4 For measuring fine spalled material, a balance having a capacity of not less than 500 g sensitive to 0.1 g shall be used. For measuring the dry weight of paver blocks, a balance having a capacity of not less than 5 000 g sensitive to 1 g shall be used.

H-2.5 The drying oven shall be capable of being maintained at 110 ± 5°C, and the rate of evaporation shall average at least 25 g per hour. This rate shall be determined by the loss of water from 1 L Griffin low-form beakers, each containing 500 g of water at a temperature of 23 ± 2°C, placed at each corner and at the centre of each shelf of the oven, and heated for at least 4 h, during which period the doors of the oven shall be kept closed.

H-2.6 The containers shall be made of non-corroding material and have such dimensions as to permit complete submersion of the specimens in the saline solution.

H-3 SPECIMENS

The paver block specimens selected as per the sampling procedure in **8** and as per the number of specimens mentioned in Table 4 shall be tested.

H-4 PROCEDURE

H-4.1 The specimens shall be oven dried for not less than 24 h and until two successive weighing at intervals of 2 h show an increment of loss of not greater than 0.2 percent of the last previously determined weight of the specimen.

H-4.2 One freeze-thaw cycle shall be completed every 24 h. The cycle shall consist of 16 ± 1 h of freezing, followed by 8 ± 1 h of thawing. If for any reason a thaw period cannot commence at the specified time, the specimens shall remain in a frozen condition until conditions are suitable for resumption of the test.

H-4.3 Following the completion of the oven drying and cooling to room temperature, the specimens shall be placed in individual containers with the bottom surface of the specimens resting on the glass, stainless steel, ceramic, or plastic spacers (approximately 3 mm high) to ensure exposure of at least 95 percent of the bottom surfaces to the saline solution.

H-4.4 The containers shall be filled with a 3 percent sodium chloride solution at a temperature of 23 ± 3°C for 24 h. The level of the solution shall be at least 2 mm above the surface of the specimens, but excess volume of solution shall be avoided in order to ensure rapid freezing of the specimens.

H-4.5 Following the 24 h saturation period, the specimens shall be subjected to continuous freeze-thaw cycles as outlined in **H-4.2**.

H-4.6 After 10, 25 and 50 cycles the specimens shall be washed with 3 percent sodium chloride solution to remove all loose particles. These particles and spalled material, collected at the bottom of the containers, shall be washed, stained through a filter, and dried to constant weight. This residue shall be defined as weight loss and expressed as a percent of the initial dry weight of the specimens. The residue shall be cumulatively weighed after 10, 25 and 50 cycles.

H-4.7 A new solution of 3 percent sodium chloride shall be used following each weight loss determination. The 24 h pre-soaking period shall be waived at 10 and 25 cycles, provided that the specimens are maintained in a saturated condition during weight determinations.

H-5 CALCULATION

H-5.1 The weight loss shall be calculated to the nearest 0.01 percent.

H-5.2 The test shall continue until 50 freeze-thaw cycles have been completed unless the test specimens have disintegrated or lost more than 1.0 percent of their original dry weight. If, because of high spalling losses or disintegration, testing of the specimen has

to be terminated prematurely, the weight loss shall be determined (*see* **H-4.6**) and added to the previous lost weight.

H-6 REPORT

The report shall include the following:

a) Identification of specimens;

b) Dimensions;

c) Weight losses of the specimens and the average results after 10, 25 and 50 cycles or at the time of termination of the test;

d) Number of cycles at termination time;

e) Visual rating of the specimens after 10, 25 and 50 cycles in accordance with the following scale:

1) 0 : no scaling;

2) 1 : very slight scaling (3 mm depth maximum. No coarse aggregate visible);

3) 2 : slight to moderate scaling;

4) 3 : moderate scaling (some coarse aggregates visible on 50 percent of the surface);

5) 4 : moderate to severe scaling (some coarse aggregates visible on 75 percent of the surface);

6) 5 : severe scaling (coarse aggregates visible on 100 percent of the surface);

f) Description of the damages suffered by the specimens, and photographs where possible;

g) Manufacturer;

h) Date; and

j) Batch.

H-7 GUIDE FOR DURABILITY CHARACTERISTICS

H-7.1 As a guide to the purchaser, the durability characteristics given in **H-7.2** may be adopted.

H-7.2 When tested in accordance with this method, the average weight loss of three paver blocks, after having been subjected to 50 freeze-thaw cycles while totally immersed in a 3 percent sodium chloride solution, shall not exceed 1.00 percent of the initial constant dry weight of the specimens.

ANNEX J

(Foreword)

COMMITTEE COMPOSITION

Flooring, Wall Finishing and Roofing Sectional Committee , CED 5

Organization	*Representative(s)*
Institution of Engineers (India), New Delhi	SHRI P. B. VIJAY (***Chairman***)
Builder's Association of India, New Delhi	SHRI PAWAN TALWAR SHRI VIJAY TALWAR (*Alternate*)
Building Materials and Technology Promotion Council, New Delhi	SHRI S. K. GUPTA SHRI PANKAJ GUPTA (*Alternate*)
Central Building Research Institute, Roorkee	SHRI B. K. RAO SHRI ACHAL MITTAL (*Alternate*)
Central Public Works Department, New Delhi	CHIEF ENGINEER (CSQ) SUPERINTENDING ENGINEER (S&S)
Central Road Research Institute, New Delhi	SHRI SATENDER KUMAR DR S. D. SHARMA (*Alternate*)
Construction Industry Development Council, New Delhi	SHRI P. R. SWARUP SHRI RAJEEV JAIN (*Alternate*)
Dyna Bricks (I) Pvt Ltd, Noida	SHRI ASHUTOSH DIKSHIT
Engineer-in-Chief's Branch, New Delhi	SHRIMATI UPINDER KAUR SHRIMATI RIVOO MAHINDRU (*Alternate*)

Organization	*Representative(s)*
Engineers India Limited, New Delhi	SHRI J. K. BHAGCHANDANI SHRI S. MAJUMDAR (*Alternate*)
Grasim Industries Limited, Jodhpur	SHRI B. C. CHATTOPADHYAYA
H.R. Johnson (India) Limited, Dewas	SHRI S. G. HEGDE SHRI G. S. PATNAIK (*Alternate*)
Indian Institute of Architecture, Mumbai	SHRI JATINDER KUMAR SAIGAL SHRI KAPIL MEHTA (*Alternate*)
Indian Institute of Technology, New Delhi	DR SUPRATIC GUPTA
Llyod Insulation (India) Pvt Limited, New Delhi	SHRI MOHIT KHANNA SHRI K. K. MITRA (*Alternate*)
Masonry Producer Association of India, Chennai	SHRI T. S. MURLI DR CHRISTOPHER SAMUEL (*Alternate*)
Modern Tiles & Marble, New Delhi	SHRI SUBHASH KAPOOR SHRI KAMESWAR RAU (*Alternate*)
National Council for Cement and Building Materials, Ballabgarh	SHRI S. K. BREJA
National Test House (NR), Kolkata	SHRI D. K. KANUNGO
National Tiles Corporation, Panchkula	SHRI PREM CHAND GUPTA SHRI S. R. GARG (*Alternate*)
Premier Polyfilm Ltd, Ghaziabad	DR SANJEEV VERMA
Prodorite Anti-Corrosive Limited, Chennai	SHRI M. ANNAMALAI DR P. SACHINDRAPAL (*Alternate*)
Public Works Department, Chennai	SUPERINTENDING ENGINEER (P&D) EXECUTIVE ENGINEER (*Alternate*)
Rashtriya Chemical and Fertilizer Limited, Mumbai	SHRI S. N. PRASAD
Research, Designs and Standards Organization, Lucknow	EXECUTIVE ENGINEER (P&DII) EXECUTIVE ENGINEER (P&D I) (*Alternate*)
Shalimar Tar Products, Kolkata	REPRESENTATIVE
Super Tiles & Marble Pvt Ltd, Mumbai	SHRI ASHOK RAJPUROHIT SHRI SUDHAKAR MODI (*Alternate*)
In personal capacity *(B-190, Sector 55, Noida-201301)*	SHRI R. S. SHUKLA
In personal capacity *[C-474B, Sushant Lok, Phase-I, Gurgaon-122002 (Haryana)]*	SHRI O. P. RATRA
BIS Directorate General	SHRI J. C. ARORA, Scientist 'E' and Head (CED) [Representing Director General (*Ex-officio*)]

Member Secretary
SHRI D. BHADRA
Scientist 'B' (CED), BIS

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Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110 002
Telephones : 2323 0131, 2323 3375, 2323 9402 *Website :* www.bis.org.in

Regional Offices :		*Telephones*
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Eastern	: 1/14 C. I. T. Scheme VII M, V. I. P. Road, Kankurgachi KOLKATA 700 054	{2337 8499, 2337 8561 2337 8626, 2337 9120
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